SCIENCE

VOL. 84 FRIDAY, AUGUST 28, 1936 No. 2174

Japanese Higher Education and Research in the Physical Sciences: PROFESSOR DUGALD C. JACKSON 189

The Spirit of Ward in Sociology: PROFESSOR STUART A. RICE 192

Obituary:
William Emilius Praeger: PROFESSOR FRANCES DIEBOLD. *Recent Deaths* 195

Scientific Events:
The Blackpool Meeting of the British Association; Summer Meeting of the Pennsylvania Academy of Science; The Second International Congress of the International Association for Testing Materials; The Annual Meeting of the American Psychological Association; The Pittsburgh Meeting of the American Chemical Society 195

Scientific Notes and News 198

Discussion:
The Preglacial Physiography of Western Ohio: PROFESSOR KARL VER STEEG. *Autotomy in a Peregrine Earthworm:* W. R. WALTON and DR. JOHN MONTEITH, JR. *Anopheles Experimentally Infected with Malaria Plasmodia:* MAJOR JAMES STEVENS SIMMONS. *Erosion on the Upper Rio Grande:* C. K. COOPERRIDER and B. A. HENDRICKS. *The Occurrence of the American Bison in Alabama and Florida:* DR. MARK F. BOYD 201

Scientific Books:
Evolution: PROFESSOR T. D. A. COCKERELL 203

Special Articles:
The Production of Cosmic Ray Showers: DR. ARTHUR BRAMLEY. *Nerve Cells without Central Processes in the Fourth Spinal Ganglion of the Bullfrog:* DR. ALFRED M. LUCAS and JOHN E. MIKSICEK. *The Thermophilic and Anaerobic Nature of Lactobacillus bulgaricus:* PROFESSOR J. M. SHERMAN and H. M. HODGE 206

Scientific Apparatus and Laboratory Methods:
A High Speed Crystal Ink Writer: DR. FRANKLIN OFFNER and DR. R. W. GERARD. *Another Method of Preparing Distribution Maps:* DR. WINONA H. WELCH. *Labeling Museum Specimens and Laboratory Equipment:* DR. E. E. JACOBS and PROFESSOR MARY AUTEN 209

Science News 6

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal
Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

JAPANESE HIGHER EDUCATION AND RESEARCH IN THE PHYSICAL SCIENCES

By Professor DUGALD C. JACKSON

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

IT is now sixty-eight years since the Shogunate was overthrown in Japan (1868) and the Emperor Meiji came into direct relation to the nation. In prior days, the feudal organization and civil wars had held the masses of Japanese population in educational darkness and superstition. The emperor Meiji proved to be a man of such force and high character as warrants him a place among the great national fathers of the world. With the aid of commissions sent to study practices in the western countries, and commanded to recommend new processes of national finance and education for Japan, progress in these lines was made rapidly and a parliamentary government ultimately was established. By the year 1872 a unified plan for education in Japan was promulgated (following rather clearly the French standards), and by 1880 compulsory education became a feature of the Empire for children up to certain ages. The mass of population was rapidly changed from the illiteracy of a feudal period to a proud proportion of literacy which vies with the record of the most literate nations of the western world. National university activities were given a suitable place in the original plan for national education, and the growing place of elementary and intermediate education in the affections of the people served as a foundation for equally effective development of university influences. The Japanese are a people of healthy, workmanlike, athletic thought, notwithstanding their reputation for sentimentalism.

At the present time in the Japanese empire there

are eight Japanese Imperial universities—six being in Old Japan and one each in Chosen (Korea) and in Taiwan (Formosa)—which are reinforced by many universities, higher scientific and commercial schools, research institutes and other higher institutions which have not yet reached the scope required for designation as Imperial universities. Some of these latter institutions are the result of private endowments, but many are supported by government funds in a manner corresponding in a degree to the support of Imperial universities. Some are sustained for particular purposes, such as education and research in the field of engineering or as institutes of research in particular branches of science; and these have no intention of expanding into the scope of three or more faculties requisite for those that are designated as Imperial universities. Important research in fields of science, with emphasis on applied aspects, is also supported by government ministries and by private industrial establishments. An official organization also exists which is somewhat analogous to our National Research Council.

The youngest of the Imperial universities is that of Osaka, which will soon celebrate the completion of five years under the Imperial designation. The oldest and culturally richest is the Tokyo Imperial University, which stands on a foundation established some sixty years ago. The physical plant of this great institution was in large measure swept away by the cataclysmic earthquake of 1923 and accompanying conflagrations. At the present time the physical plant has been mostly replaced in improved form, and further new construction is in progress. The library building of this university and its contents having been (as one item of that fateful day) swept away by the earthquake and fire to a substantially total loss, Mr. John D. Rockefeller, Jr., provided funds for rebuilding, and a central feature of this university is the great library resulting thus from Mr. Rockefeller's gift. Most of the remainder of construction funds have come from government in so adequate amounts that the Tokyo Imperial University now possesses one of the great university centers of the world. The faculties of the university are in keeping with the excellence of their setting.

The other university centers in Japan are not so extensive and magnificent as that of the Tokyo Imperial University; but they all are in keeping with their purposes and the greatness of the Japanese nation. All possess faculties actively working within their various fields. The Japanese scientific education and scientific output are of distinguished character within the fields cultivated and to the extent of their cultivation.

Two visits to Japan six years apart, each of many weeks' duration, have enabled the writer to closely observe the status of science in the universities and the research institutes at the present time, and the rate of progress which characterizes Japanese science. The opportunities have been those of personal observation at the sites of all six of the Imperial universities in the principal islands of Japan and of various other Japanese universities, research institutes, departmental laboratories and other institutions supporting education or research in science. While few if any of the universities attempt to cultivate all fields of science, the cultivation is very wide-flung in the aggregate for the pure sciences, and in the scope of applied sciences great emphasis is placed on agriculture, forestry, fisheries, medicine (including sanitation) and engineering.

The writer's interest being primarily in engineering, attention in this article is directed to the physical sciences (physics and chemistry, interpreting these words broadly) and their applications in engineering. A country coming in the last half of the nineteenth century, as a novice, to develop a western type of education in science, appropriately should give much emphasis to the applications and rely at first on the already established nations for the background of discoveries on which to build. The wisdom of the Japanese led them to that practice; but they are now, after a half-century of experience, established in full appreciation of the advantages to themselves of participating with the other nations in research relating to the fundamental aspects of science, but without lessening their attention to the useful applications. As yet this attitude relates mostly to experimental science. Pure mathematics, mathematical-physics and other philosophical sciences are not yet so fully developed, but an obvious interest in the farther development of these subjects is observable.

The internal organization of the Japanese universities usually is European rather than American in type. The Ministry of Education of the Imperial government has a strong influence in Japanese university affairs. There is more formality in administering university affairs than we are accustomed to, and there is more of watertight division and less of cooperation between departments than our experience leads us to believe is desirable. Research with them is a formal enterprise and there is less association between professors and students in research than we are inclined to cultivate wherever students are found suitably prepared for research in their subjects. There is quite a difference in some of the terminology describing the universities as translated by the Japanese from their language into English and as used by Americans in relation to our institutions. For illustration, the Japanese are likely to apply the word institute to a

university division which we would commonly refer to as a department, and the Japanese sometimes use the word department in application to a section of a university such as we would call a school or college. However, the branches of learning supported in Japanese universities are truly universal and such as may be found in the universities of any of the great nations of the world, with changes of emphasis which may be appropriate to the circumstances. And in love for their work, on the part of professors and students, the personnel of the Japanese universities seems much like the personnel of American universities.

The Hokkaido Imperial University, located in the relatively new city of Sapporo in the Island of Hokkaido, is the farthest north of any of the Imperial universities on the principal islands of Japan. It was founded with the improvement of agriculture as a prime objective and its first leader was American—one brought to Japan from the Massachusetts College of Agriculture. This was decades ago, but his name is still revered in informed circles of Japanese higher education. His mark also is maintained, *inter alia*, by the excellent apples of American varieties which are now grown in Hokkaido and in the northern part of Honshu, the main island. In the meantime the university has expanded to the full Imperial scope and excellent work is found in several branches of physical science. The early faculty of this university contained many Americans and other westerners. Indeed, the early faculties of several Imperial and other Japanese universities contained numerous westerners, and various Europeans and Americans who later in the West held high reputations in fields of science were, as young men, in university posts in the developing universities of Japan, while native Japanese of sufficient capacity and experience were being developed to fill the posts. Now, it is substantially universal for the university posts of importance in Japan to be filled by native Japanese, many of whom have been tested by the pursuit of graduate studies and research in Europe or America. Westerners of distinction in their branches are now freely invited to the Japanese universities as temporary professors or special lecturers. The bar of language differences interferes with the efficiency of such temporary imports in education, but they plainly have a good influence within the field of science by maintaining a certain degree of international contacts.

At Sendai, a night's railroad trip north of Tokyo, is located the Tohoku Imperial University, which is known by reputation wherever metallurgists congregate on account of the great work of Professor Honda (now president of the university) and his institute of research in the metallurgy of alloy steels and particularly of magnet steels. Professor Honda's work is turning toward the influences of very low temperatures on the characteristics of steels and other metals, for which work his laboratory now is well equipped. The university and research institute affiliated with it also support various other men of productivity in the fields of chemistry, physics and engineering, and the institution is an important center of science for Japan. Its geographical location makes it easier of access than Hokkaido University, and the foreigner studying Japanese higher education on the ground is more likely to become familiar with it.

The most southerly of the Imperial universities on the principal islands is the Kyushu Imperial University at Fukuoka (or Hakata) on the populous island of Kyushu. This is in the midst of a fertile agricultural and horticultural region and at the edge of an active coal-mining and steel-manufacturing area. The university is full of scientific activity and appears to have progressed greatly in influence during the past decade, so that it is more nearly an even rival of Kyoto Imperial University, located in the lovely city of Kyoto, which city retains to itself its old-time Japanese artistic and leisurely character to a fascinating degree.

Osaka Imperial University and Kyoto Imperial University are in locations about an hour's distance from each other by fast railroad train. The city of Osaka is the kernel of a densely industrialized area, with a crowded population of several million people, which gives an impression somewhat like Chicago. On the other side of Kyoto lies Nagoya, another modernly industrialized area but in which a good deal of the old-time artistic, individual craftsmanship of Japan is still maintained in a manner reminiscent of Kyoto. Here there is located a higher technological school and other higher schools. At Kobe, the important port to the west of Osaka, are the notable Japanese meteorological laboratory and an important higher commercial school; and in Kyoto, in addition to the great Kyoto Imperial University, there is located Doshisha University, where science is embraced to a moderate extent. This great area of art and industry is thus well supplied with facilities for higher education relating to the physical sciences. Osaka Imperial University is still young, but at Kyoto Imperial University research in the physical sciences goes on with vigor and productivity.

Upon turning to Tokyo we find that city associated with Yokohama and two intervening lesser industrial municipalities into an area of continuous urban population which is one of the most populous urban areas of the world, rivalling New York and London in total number of inhabitants. This is Japan's greatest center of commerce, finance, industry and diplomacy. Tokyo is the seat of the Imperial government with its im-

perial residence, its ministries and its parliament house. Tokyo Imperial University occupies an important site in Tokyo, and other institutions of higher education and research occupy additional fitting localities in Tokyo and Yokohama. Here are Tokyo University of Engineering, the corresponding technological college in Yokohama, the famous research institute of physics and chemistry, the equally famous earthquake research institute, the extensive research laboratories of the Ministry of Communications, the Ministry of Railways and of other Ministries (certain of which do work similar to that of our own Bureau of Standards). The headquarters of meteorological research are located here, although the major meteorological work is carried on at the Kobe site, under the eye of Director Horiguti. Tokyo is also the home of Waseda University and other universities depending on private endowments for their support, in most of which science is given a fitting place.

It is impracticable to enumerate all the important research laboratories which the government and the various Japanese industries support in this area. The area is one of great intellectual effort in science, with achievements that are in keeping with the excellence of the facilities provided. Altogether, Tokyo is a center of culture to which western scientists might well give more serious attention; and which western students in science might fruitfully visit for observation and study, except for the inconvenience of a language in which the structure differs so radically from any western language in both its spoken and written forms. This difficulty, however, is softened by the fact that most of the cultured Japanese are somewhat familiar with the English language and many are facile in their use of English.

Japan is deeply affected by the electric forces set up by industrialization, which forces draw people into increasingly populous urban areas; and the Japanese people are now at a disadvantage because their government is mostly in the hands of men who thus far have had little personal experience in dealing with those forces or in moulding their influences. Education in science seems to possess a satisfactory status of independence and liberality, but a disturbing aspect is arising which affects philosophical and historical scholarship. Comprehensive scholarship in historical, ethnological and archeological fields is still in a germinal stage in the Japanese universities, and efforts to fertilize its development along investigational lines are frowned on from some official circles. This situation has analogies to the situation in America sixty years ago when, in theology, the "higher criticism" was in its early stages; except that the situation is more serious in Japan because it is official efforts at repression that there invade the privileges of the universities to investigate freely and to express developed opinions openly. An independent newspaper published in Japan recently expressed the situation editorially in the words, "These are days when orthodoxy is very nervous and freedom is looked upon as a rather regrettable principle to have been adopted," referring to freedom of thought and opinion in religion and politics. Remembering that "he who keeps the hills, burns the wood," the situation is one for great concern in all scholarly circles. As yet it does not seem to have brought restraint into the circles of the physical sciences, but western experience has shown that the scholarly pursuit of learning in every branch is ultimately affected disadvantageously when forcible restraint is applied to the pursuit of truth in any of the learned branches. On account of the well-demonstrated wisdom of the Japanese people, there is good ground for hope that the disturbing effort at restraint on freedom of research and the discussion of results will blow over, as it did in America, before great permanent harm has resulted.

THE SPIRIT OF WARD IN SOCIOLOGY[1]

By Professor STUART A. RICE

CHAIRMAN, UNITED STATES CENTRAL STATISTICAL BOARD; PROFESSOR OF SOCIOLOGY AND STATISTICS, UNIVERSITY OF PENNSYLVANIA (ON LEAVE)

WHEN Dr. Wells suggested my topic, "The Spirit of Ward in Sociology," I did not quite know how to deal with it. Later, it occurred to me that perhaps the topic held a deeper significance than either he or I had appreciated. We of this generation of sociologists are trying to build a science of sociology. Science as it is known in the physical world—I do not want to exclude the social world from the domain of science—evolves by a slow accretion of knowledge. Science *grows*, bit by bit, each brick in the structure being laid upon the bricks which were laid before. Some-

[1] Remarks as guest speaker at the founding of the Lester F. Ward Sociological Society of The George Washington University, Washington, D. C., on April 16, 1936.

times, of course, whole wings of the building are abandoned but that does not detract from the general view of science as a slow and orderly accretion.

Now social science—I will use the terms "sociology" and "social science" interchangeably in this context—has been a field of discussion since Aristotle. But has it been science, in the sense I have just described? I think we would agree that it has not. I think that right up to our own day sociologists, for example, have been distinguished for their influence upon the ideals, the philosophy, the points of view, of their time and place, and not for their contributions to *knowledge*, in a scientific sense. It has been their "spirit," in other words, rather than their scientific contribution, that has been noteworthy. This has been true of Ward no less and no more than of Giddings, who differed in view-point so widely from Ward, and whose spiritual contribution consisted so greatly in its emphasis upon the need in sociology for the development of science through measurement.

It is, therefore, appropriate to speak of the *spirit* of Ward in sociology. It would not be so appropriate —I think it would sound peculiar in your ears—to speak of the spirit of Ward in geology or paleontology, to which subjects he made—we have just been informed—definite scientific contributions.

I am always a little hesitant when I talk about the work of the great sociologists of the past, for I am not by inclination destructive. Each of them builds up a philosophical system, and then the commentator who follows is expected to step in and shatter the system. I feel a little like two gentlemen last winter when the weather was cold. They were persons of leisure—I might call them "men about town"—and they did not have overcoats. They were passing the Art Museum, and decided to go in and look at the statuary as a means of whiling away the hours until the doors of their municipal lodgings should be open for the evening. Successfully passing the attendant at the door, our critics ventured down the corridor and presently came to a stop before a replica of the Venus de Milo. They looked at it sharply, and then, with alarm, at each other. "Bo," said one, "we'd better be gettin' out of here quick before somebody says we done it!"

As befits an uneasy task, I presume I should attempt as quickly as possible to sum up Ward's spiritual legacy as I see it. I should say in the first place that his influence has not been limited to sociology. It has had a profound effect on current thought. Without attempt at an erudition concerning his influence that I have had no opportunity to acquire, I should say that he has aided in the establishment of a belief in the possibility of purposeful social self-control. There is much about us here in Washington to-day which we might attribute to Ward and which is at least in conformity with his thinking. The present Administration assumes the possibility of purposeful social self-control, and any administration which follows this one can not avoid attempting to do very much the same sort of things to which the present Administration is committed. Any government, any system of society, at this time and place in the world's history, is compelled to make and act upon such an assumption. From this standpoint, Ward's faith in the possibility of "telesis" takes on something of a prophetic cast.

The previous speaker, Dr. Stanton, has noted what seems to me a very significant thing about Ward's personal history. He was not primarily a sociologist but a botanist, geologist and paleontologist. In these latter capacities he had a place in the Government Service; but as a sociologist he was compelled to function outside of the Government Service. As a sociologist in Washington he was "on his own," and he finally left governmental employ to extend his sociological interests in a university, where his intellectual and vocational activities might coincide. To-day the reverse is true. Men are coming from the social science departments of the universities to the government. That reversal in the direction of migration among sociologists between Ward's day and ours is a measure of the changes that have taken place in our subject.

The sociology of Ward's day, as I have said, was philosophy, and sociology has since remained very largely philosophical. It is nevertheless in the process of becoming scientific. That process has involved a breaking up of the cosmical grandeur of the subject. It is being resolved into a diversity of specific problems, having sufficiently small dimension for individuals to grapple with them. It is because the cosmical philosophies of the Ward and Spencer generation have been broken down in our day into concrete and manageable units of investigation that social scientists are being called from the universities into the government. This applies not only to the Federal Government, but to state, municipal, business and organizational activities. This kind of sociological activity has brought to Washington from the universities perhaps 30 or more sociologists and a considerably larger number of economists and statisticians. Theirs is the kind of social science out of which accretions to scientific knowledge will come. From it likewise will come, eventually, new generalizations on the grand scale, as in physical science. I agree with my good friend Ellwood that we need a new social philosophy, but I do not agree with him as to how we are going to get it. We will resynthesize our social philosophy out of the specific,

concrete, factual kinds of study to which Park refers in the letter we have heard, and these factual studies will relate to pressing social problems that our present society must try to solve. On this latter point Professor Ellwood and I would probably agree.

I have tried to indicate that we are in the process of change from a sociology in which it would be appropriate to speak of the *spirit* of sociologists to one in which it is appropriate to speak of their *contributions*. In this process, sociology and the other social sciences are encountering the pains of transition that normally accompany growth anywhere. The social philosopher does not have to put his theories to the test; he can take the whole cosmos as his field of speculation, but he is not called upon to check up and verify with statistical indexes and representative samples. Science, on the other hand, does have to be verified, to be checked up, and it is often very uncomfortable when our work is checked up. Moreover, sociologists are being called upon to deal with extremely practical problems when their training has been of a type regarded by many as impractical or idealistic.

During my past three years in Washington I have developed a view-point concerning the rôle of academic people in the economic, sociological and statistical agencies of the government. New problems are all about us—problems that have to be solved and dealt with in new ways. To solve and deal with them, theoretically trained persons with disciplined minds are required. Yet it is said that the university man and the academic man are not practical. There is a large measure of truth in this criticism for the reason that I have mentioned—their training has been exclusively along theoretical lines. They have not learned to wrestle with commonplace realities, many of which still survive in the situations to be dealt with. On the other hand, there is no one more impractical than the so-called "practical" man, when the conditions to which the latter has been accustomed are undergoing change. Typically, he is unable either to comprehend or to grapple with the altered conditions, and continues a futile attempt to apply his time-honored rules-of-thumb when these are no longer applicable. The point to the paradox is that the academic man has something that the practical man can not supply, but he also lacks something realistic that the so-called "practical" man has. In recruiting technical personnel for the government service, it has been my experience that good mental qualities and thorough theoretical training are only part of the required qualifications. The other part is that a candidate shall be able to "find his way around" in the workaday realities of the daily tasks assigned him.

There is another point at which it seems to me that the deeper implications of Ward's faith in purposeful social self-control are at variance with the actual effects up to date of his ideology. The notion of *telesis* is essential to the theories of those who would reorganize society along new and allegedly better lines. Ward is thus a patron saint of social radicals. On the other hand, the demands of *social planning*—to employ a more current term—are such as to produce a classification of people in accordance with their ability to make the social organism function, rather than in accordance with their emotional desires for a preservation or a reordering of the social structure.

If I may again be personal, three years in Washington have given me a very different concept of the way in which people should be classified for practical purposes. When I was a small boy, I inferred that people were naturally divided into Republicans and Democrats, until I learned that there were also Socialists and "other lesser breeds without the law." Later on, in the university, I discovered that Democrats and Republicans were not realistic divisions of mankind, and I began to think of people as conservatives or radicals, irrespective of party. In more recent years I find that I have lost much of my former interest in this classification. I have come to think of persons as classified according to their ability to think and act intelligently, competently and precisely in realistic situations. Whether they are capitalists or socialists does not seem to me as important as it used to, for those terms refer to idealogies that have no immediate significance in 98 per cent. of the situations encountered in the real world. What difference do these idealogies make, as compared with the individual's capacity or incapacity to do the job in hand competently? The great lack under any kind of social organization, capitalistic, fascistic or communistic, will always be that of competent men and women, having ability to do the day's work and to manage the complexities of organization that are bound to exist. As long as inventions continue, society, under whatever form of organization, will become more and more complex, and its functions will become more and more difficult to coordinate and direct. Hence, we will need more and more to have scientifically trained, practically minded leaders, to carry on the practical job of enabling society to function under whatever system you please. These leaders, whether known by the name or not, will have to be social scientists if they are to be effective. There will never be enough people who are capable of making the social organization run. Ward's spirit is of assistance here, for he has helped to give us confidence that we can organize and control society collectively and make it work; and by such working bring about a progressively higher level of human satisfactions.

OBITUARY

WILLIAM EMILIUS PRAEGER

WITH the sudden death of Dr. Wm. E. Praeger on August 13, the State of Michigan lost one of its well-known and distinguished biologists. Until his retirement as professor emeritus in 1934 at the age of seventy-one years, Dr. Praeger for twenty-nine years was head of the biology department at Kalamazoo College. During these many years he exerted a great influence alike in civic affairs and in various academic fields. The writer, as a close associate of Dr. Praeger, first as instructor in the department and later as his successor, always found him a loyal and good friend, his presence ever keenly inspiring.

Dr. Praeger's scientific affiliations were numerous; they included being a fellow in the American Association for the Advancement of Science, a life member of the American Genetic Association, an honorary associate of the American Ornithological Union and a member of the Ecological Society. He also was counted among the oldest members of the Michigan Academy of Science and served that organization as president in 1911. He had been a member of the Michigan Schoolmasters' Club since 1906, having been its president in 1921. Dr. Praeger was a graduate of the University of Illinois and of Chicago. He was born and received his early education in Ireland. Living there he has a sister, Rosamond, who is a well-known Irish sculptress and painter, and a brother, R. L. Praeger, who is professor of botany at the University of Dublin.

FRANCES DIEBOLD

RECENT DEATHS

EDWARD WESTON, distinguished for his invention and development of electrical measuring instruments of precision, chairman of the board of the Weston Electrical Instrument Company, died on August 20 at the age of eighty-six years.

DR. CHARLES GILBERT CHADDOCK, professor emeritus of diseases of the nervous system at St. Louis University, died on July 20 at the age of seventy-four years.

WILLIAM JOHN SQUIRRELL, head of work in field husbandry at the Ontario Agricultural College, died as the result of an automobile accident on July 25. He was fifty-six years old.

DR. H. A. D. JOWETT, manager of the Wellcome Chemical Works at Dartford, England, died as the result of an automobile accident on August 10, at the age of sixty-six years.

DR. PIETRO ROMUALDO PIROTTA, professor of botany in the University of Rome, died on August 4 at the age of eighty-three years.

SCIENTIFIC EVENTS

THE BLACKPOOL MEETING OF THE BRITISH ASSOCIATION

IN the issue of SCIENCE for May 15 there was given a forecast of the Blackpool meeting of the British Association for the Advancement of Science, to be held from September 9 to 16. The issue of *Nature* for August 15 contains some further details in regard to the meeting. Public lectures have been arranged as follows:

"The Scope of Photography," Dr. Olaf Bloch.
"Science and the Glass-house Industry," Dr. W. F. Bewley.
"Who Were the Greeks?" Professor J. L. Myres.
"Some Recent Advances in Astronomy," Sir James Jeans.
"Applications of Science to Poultry Farming," P. A. Francis.
"Common Shore Animals," Professor C. M. Yonge.
"Joy in Scientific Discovery," Dr. D. F. Harris.
"Splashes and What They Teach," Professor Allan Ferguson.

There will be lectures for school children by H. S. L. Winterbotham on "How Maps are Made" and by D. Seth-Smith, on "Favorites of the London Zoo."

The evening discourses, to be delivered by C. C. Paterson and by Captain F. Kingdon Ward, on "Science and Electric Lighting" and on "Plant-hunting and Exploration in Tibet" are open to members only.

In addition to sectional excursions and the social events that have already been announced, the Mayor and Mayoress of Blackpool (Alderman W. Newman and Miss Newman) invite members to a reception in the Winter Gardens on Thursday, September 10. The head master of Rossall School (Mr. H. G. M. Clarke) will entertain four hundred members at a garden party at the school on Tuesday, September 15. The Rotary Club will hold a luncheon on Thursday, September 10, when the president will address the members and their guests. The official service will be held at St. John's Parish Church on Sunday, September 13, when the Right Rev. the Lord Bishop of Blackburn will preach the sermon.

Thirty sectional excursions and visits have been arranged, of geological, botanical, antiquarian, engineering and educational interest. Their range in

space is as wide as their range in subject. There are planned a visit to the Amusement Park, an excursion to the Lake District and a visit to the open-air swimming bath hard by, an excursion to Garstang, Furness Abbey and the Southport Sand Dunes, Stonyhurst and Rossall, Fleetwood Fish Docks and the Fylde Farms.

As has been already noted in SCIENCE, the address of the president, Sir Josiah Stamp, will be on "The Impact of Science on Society."

SUMMER MEETING OF THE PENNSYLVANIA ACADEMY OF SCIENCE

THE Pennsylvania Academy of Science held its regular summer meeting at Somerset on Friday and Saturday, August 14 and 15. The program was devoted chiefly to field trips. Members assembled at noon on Friday and were offered a choice of two trips. Dr. E. M. Gress, state botanist, led a group to localities of floral interest. R. W. Stone, of the Pennsylvania Topographic and Geologic Survey, conducted those interested in geology to the Castleman River Gorge. On Saturday the entire group joined in an all-day trip. Of particular interest to the botanists was the opportunity to study swamp-dwelling plants. The physiography of the region was discussed to advantage from Mt. Davis on Negro Mountain, the highest point in the state. Luncheon was served at C.C.C. Camp S-97 near Salisbury, after which a tour of the grounds and buildings was led by the camp officials.

On Friday evening a session was held at the Ferner Hotel, Somerset. President T. D. Cope presided. Papers on phenomena of local interest were read by V. M. Bearer, district forester, Dr. Paul R. Stewart, of Waynesburg College; Dr. E. T. Wherry, of the University of Pennsylvania; M. Graham Netting, Carnegie Museum, and R. W. Stone, Pennsylvania Geologic Survey. A discussion and business meeting followed the presentation of the papers. It was voted that the annual grant-in-aid of the academy should be given to Dr. and Mrs. R. J. Greb for 1936 to be used in their biologic studies.

About forty members attended the field trips. This number was considerably augmented at the evening gathering by local residents, since the program was open to the public.

BRADFORD WILLARD,
Press Secretary

THE SECOND INTERNATIONAL CONGRESS OF THE INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS

THE second International Congress of the International Association for Testing Materials will be held in London from April 19 to 24, 1937. The first congress was held in Zurich in September, 1931.

The object of the congresses held by the International Association for Testing Materials is to obtain international cooperation in the study of materials and their testing and to provide facilities for the exchange of views, experience and knowledge with regard to all matters connected with this subject. It is expected that the London congress will be of considerable scientific and industrial importance, particularly in view of the length of time which has elapsed since the study and testing of materials were last reviewed on an international basis.

The proceedings will be based on selected papers which, by invitation of the group presidents appointed by the permanent committee, have been contributed by leading authorities in their respective fields in the principal countries throughout the world. Most of these invitations have been issued and approximately 150 papers have been promised.

The organization of the congress has been undertaken by an Organizing and Reception Committee, which consists of the British Committee of the International Association for Testing Materials and representatives of many leading British technical institutions, scientific societies and industrial organizations. The Executive Committee of the Organizing Committee is composed as follows: Sir Frank Smith, secretary of the Royal Society of Great Britain and secretary of the Department of Scientific and Industrial Research, *chairman;* Sir William Larke, *vice-chairman;* Sir Harold Carpenter, Sir Alexander Gibb, Dr. H. J. Gough, Sir Nigel Gresley, Sir Clement Hindley and K. Headlam-Morley, *honorary secretary.* Sir William Bragg, president of the Royal Society and director of the Royal Institution of Great Britain, has consented to be president of the London congress.

Participation in the congress will be open to all interested in the study of materials and their testing on payment of the membership fee.

The subjects selected for discussion are divided into four groups dealing respectively with metals, inorganic materials, organic materials and subjects of general importance. The following subdivisions of these groups have been adopted:

GROUP A—*Metals.* (*President:* Professor C. Benedicks, Sweden; *Vice-president:* Dr. H. J. Gough, Great Britain.)

(1) Behavior of Metals (mechanical and chemical) as dependent upon temperature, particularly in regard to high temperatures.
(2) Progress of Metallography.
(3) Light Metals and their Alloys.
(4) Wear and Machinability.

GROUP B—*Inorganic Materials.* (*President:* Professor E. Suenson, Denmark; *Vice-president:* Director P. K. van der Wallen, Holland.)

(1) Concrete and Reinforced Concrete.

(2) Erosion and Corrosion of Natural and Artificial Stone.
(3) Methods of Testing Ceramic Bodies.

GROUP C—*Organic Materials.* (*President:* Dr.-Ing. R. Barta, Czechoslovakia; *Vice-president:* Professor Roos-af-Hjelmsäter, Sweden.)
(1) Textiles.
(2) Wood Cellulose.
(3) Timber Preservation.
(4) Aging of Organic Materials.
(5) Colors and Varnishes.

GROUP D—*Subjects of General Importance.* (*President:* M. H. Rabozée, Belgium; *Vice-president:* Professor Dr. M. Roš, Switzerland.)
(1) Relation between the results of laboratory tests and behavior in use and service.
(2) The bearing of recent advances in physics and chemistry on the knowledge of materials.
(3) The properties of materials for the thermal and acoustic insulation of buildings.

A congress book will be issued, which will contain, in addition to the papers presented, an account of the proceedings and articles by each of the four group presidents, in which attention will be directed to the principal additions to knowledge recorded. Advance copies will be available to members. The papers will be printed in English, French and German, in which languages the proceedings of the congress will be mainly conducted.

In addition to the technical sessions, numerous visits to places of scientific and industrial interest will be arranged, as well as excursions and social functions, including a banquet, a dance and official receptions. All requests for further information and inquiries should be addressed to the Honorary Secretary of the congress, K. Headlam-Morley, at the offices of the British Committee, The International Association for Testing Materials, 28, Victoria Street, London, S.W.1.

THE ANNUAL MEETING OF THE AMERICAN PSYCHOLOGICAL ASSOCIATION

THE forty-fourth annual meeting of the American Psychological Association will be held at Dartmouth College, Hanover, N. H., on September 2, 3, 4 and 5. The address of the president, Dr. Clark L. Hull, of Yale University, which will be given on Friday evening, is entitled "Mind, Mechanism and Animal Behavior."

The sessions of the association with their chairmen, are as follows:

Wednesday, September 2

General Program: Clark L. Hull, Yale University.

Animal Psychology I: Harvey A. Carr, University of Chicago.

Political Psychology: Edward L. Thorndike, Teachers College, Columbia University.

Vocational Psychology: A. T. Poffenberger, Columbia University.

Visual Phenomena: Madison Bentley, Cornell University.

Abnormal Psychology I: H. L. Hollingworth, Barnard College, Columbia University.

Infant Behavior: John E. Anderson, University of Minnesota.

Research and Instructional Films: Clark L. Hull, Yale University.

Thursday, September 3

Cortical Function: Karl S. Lashley, Harvard University.

Social Psychology: J. McKeen Cattell, New York.

Child Psychology: Florence L. Goodenough, Institute of Child Welfare, University of Minnesota.

Human Learning I: Robert S. Woodworth, Columbia University.

Electrophysiology: Walter R. Miles, Yale University.

Personality: L. L. Thurstone, University of Chicago.

Cutaneous Phenomena: E. S. Robinson, Yale University.

Friday, September 4

Psychometrics: Herbert Woodrow, University of Illinois.

Conditioned Responses: Leonard Carmichael, University of Rochester.

Emotion and Motivation: Harold E. Burtt, The Ohio State University.

Auditory Phenomena: Harold E. Jones, University of California.

Abnormal Psychology II: John A. McGeoch, Wesleyan University.

Human Learning II: Walter S. Hunter, Brown University.

Saturday, September 5

Educational Psychology: Mark A. May, Yale University.

Animal Psychology II: Robert M. Yerkes, Yale University.

Work and Fatigue: Henry E. Garrett, Columbia University.

There will be round table and panel discussions, with subjects and chairmen as follows:

"Substitute for the I.Q.": Francis N. Maxfield, The Ohio State University.

"The Subject Matter of Social Psychology": Floyd H. Allport, Syracuse University.

"Behavior and Endocrine Disjunction": Florence Mateer, Wayne Clinic, Pa.

"Clinical Psychology and Social Work": Clara Harrison Town, The Psychological Clinic, Children's Aid Society, Buffalo, N. Y.

"In What Ways Can the Course in Educational Psychology be Made More Functional?": D. A. Worcester, University of Nebraska.

"Methodology in Learning": Walter S. Hunter, Brown University.

THE PITTSBURGH MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE Pittsburgh meeting of the American Chemical Society will be held from September 7 to 11. Dr. Edward Bartow, of the State University of Iowa, is the retiring president, and Dr. Edward Ray Weidlein, director of the Mellon Institute for Industrial Research, Pittsburgh, is president-elect.

On Wednesday, September 9, the "Central Day" of the meeting, the following program has been arranged:

9:00 A. M.—Open House in Oakland. Inspection of Carnegie Institute, Carnegie Institute of Technology, Cathedral of Learning and the University of Pittsburgh, Mellon Institute of Industrial Research and the U. S. Bureau of Mines. Members are requested to visit these institutions only on Wednesday morning.

12:00 M.—Group Luncheons in Oakland.

2:00 P. M.—General Meeting, Carnegie Music Hall, Oakland.

Pittsburgh Award, followed by three general papers:

E. F. Armstrong, president, Association of British Chemical Manufacturers, "Whither."

Friedrich Bergius, Nobel Laureate, general director, Deutsche Bergin, A.-G., Heidelberg, "Problems of Industrial Pioneer Work."

John Johnston, director of research, United States Steel Corporation, "Some Aspects of the Chemistry of Steel."

7:00 P. M.—Subscription Banquet ($3.00), Ballroom and Urban Room, William Penn Hotel.

9:00 P. M.—Following the banquet the American Chemical Society Award in Pure Chemistry (initiated by A. C. Langmuir) of $1,000 will be presented to John Gamble Kirkwood.

President's Address, Edward Bartow, "Progress in Sanitation."

10:00 P. M.—Dancing, Music and Bridge.

A large number of technical papers will be read before the seventeen divisions of the society, which are as follows: Agricultural and Food Chemistry, Biological Chemistry, Cellulose Chemistry, Chemical Education, Colloid Chemistry, Fertilizer Chemistry, Gas and Fuel Chemistry, History of Chemistry, Industrial and Engineering Chemistry, Medicinal Chemistry, Organic Chemistry, Paint and Varnish Chemistry, Petroleum Chemistry, Physical and Inorganic Chemistry, Rubber Chemistry, Sugar Chemistry and Water, Sewage and Sanitation Chemistry.

A special luncheon to celebrate the thirtieth anniversary of *Chemical Abstracts* will be given on Tuesday, at which President Edward Bartow, for twenty-six years assistant editor of *Chemical Abstracts;* President-elect E. R. Weidlein; Secretary Charles L. Parsons, and W. A. Noyes, the first editor of *Chemical Abstracts,* are expected to be present.

SCIENTIFIC NOTES AND NEWS

KING VICTOR EMMANUEL of Italy has conferred on Professor Sir Aldo Castellani, surgeon-general of the Italian forces in East Africa, the hereditary title of Count of Kisymaio for his work during the Ethiopian campaign, "in successfully keeping the troops in excellent health." Dr. Castellani has been professor of tropical medicine at the School of Medicine of the Louisiana State University, professor of tropical medicine in the Royal University of Rome, lecturer in the London School of Tropical Medicine and director of the Ross Institute, London.

THE German Bunsen Society for applied physical chemistry has awarded the Bunsen Medal to Professor Max Bodenstein, of the University of Berlin.

THE council of the British Medical Association has awarded the gold medal of the association to Dr. Harry Guy Dain, of Birmingham, "in recognition of his distinguished work in connection with the administration of the medical benefit of the National Health Insurance Acts and of the outstanding services he has rendered to the British Medical Association."

THE Royal Photographic Society of Great Britain has awarded the Progress Medal to Arthur Samuel Newman "in recognition of his researches and inventions which have resulted in important advances in photography."

FELLOWS of the French Academy of Surgery have been elected as follows: Professor d'Arsonval, of the College of France; M. Leclainche, vice-president of the Paris Academy of Sciences; the roentgenologist, Antoine Béclère, and Dr. Claude Regaud, professor at the Pasteur Institute.

THE Paris Academy of Sciences has elected as correspondent in the section of botany Dr. A. Maige, professor of botany in the University of Lille, to fill the place of the late H. Jumelle, professor of botany in the University of Marseilles.

A DINNER in honor of Dr. Dexter S. Kimball, who recently retired as dean of the College of Engineering of Cornell University, was given on August 28 by the Cornell Clubs in the San Francisco district.

DR. WARREN H. COLE, who recently resigned as assistant professor of clinical surgery at the Washington University School of Medicine, St. Louis, to

become professor and head of the department of surgery at the University of Illinois College of Medicine, Chicago, was the guest of honor on July 10 at a farewell dinner given in St. Louis by his friends and colleagues.

Nature reports that a volume of anthropological essays by friends and former pupils, entitled "Custom is King," has been presented to Dr. R. R. Marett, reader in social anthropology and rector of Exeter College, Oxford, to mark the occasion of his seventieth birthday. The presentation was made in the College Hall by an undergraduate, and was attended by the vice-chancellor, a number of heads of houses and professors. The chair was taken by Sir Charles Harper, a former pupil.

THE *Journal* of the American Mathematical Society states that Dr. Henry Seeley White, professor emeritus of mathematics at Vassar College and past president of the society, has been honored by a dinner given by members of the Vassar faculty. About ninety guests were present. Professor White had been chairman of the department of mathematics since 1905, and became professor emeritus in 1933. For the last three years until his final retirement last June he has held the title of senior lecturer. President H. N. MacCracken as toastmaster introduced the after dinner speakers. These were: Dr. Grace Macurdy, of the department of Greek; Dr. H. E. Mills, professor emeritus of economics; Dr. T. S. Fiske, professor emeritus of mathematics at Columbia University and chairman of the College Entrance Examination Board; Dr. H. S. Taylor, professor of chemistry at Princeton University, and Dr. M. E. Wells, professor of mathematics at Vassar.

CHANGES in the staff at the recently established Institute of Technology of the University of Minnesota, of which Dr. Samuel C. Lind is director, include the following: Professor Peter Christianson, retiring as professor of ferrous metallurgy, has been made emeritus professor and will be replaced by T. L. Joseph, supervising engineer of the North Central Experiment Station of the U. S. Bureau of Mines, University of Minnesota. Frank W. Scott, of the Inland Steel Company of Chicago, has been appointed instructor in metallurgy. Professors L. I. Smith and L. G. Straub have been made administrative assistants in chemistry and engineering, respectively. Dr. George Glockler and Dr. R. E. Montonna have been promoted to full professorships in chemistry and chemical engineering. Dr. D. E. Hull, National Research Council fellow, has been appointed instructor in physical chemistry to take charge of the work in radioactivity. Miss Isabella Webster has been appointed instructor in organic chemistry.

DR. HOBART A. REIMANN, associate professor of medicine at the University of Minnesota and at the Graduate School of Medicine, Minneapolis-Rochester, has been appointed Magee professor of the practice of medicine and clinical medicine at Jefferson Medical College, Philadelphia.

DR. HANS JENNY, assistant professor of soils at the University of Missouri, will join the faculty of the University of California.

DR. E. J. ALLEN, who has been director of the Marine Biological Station at Plymouth, England, for forty-two years, will retire on September 30. In his place the council of the Marine Biological Association has elected Dr. Stanley Kemp, who directed the researches of the *Discovery* on the habits and life histories of the southern whales.

DR. J. BASIL BUXTON, professor of animal pathology in the University of Cambridge and director of the Institute of Animal Pathology and of the University Field Laboratories, has been appointed by the governors of the Royal Veterinary College acting principal and acting dean of the college from September 25, to succeed Sir Frederick Hobday as principal and dean on the latter's retirement. This will not, however, take place until the opening of the main block of the new college buildings.

THE Royal Academy, London, has appointed Dr. H. J. Plenderleith, of the British Museum Research Laboratory, to be professor of chemistry in succession to Dr. A. P. Laurie, whose term of office has expired. The professor of chemistry gives six lectures at the Royal Academy in October and November. They are primarily intended for students of the Royal Academy, but they are open to students of other art schools and Royal Academy exhibitors of the year who may wish to attend.

DR. W. H. TAYLOR, assistant lecturer in physics at the University of Manchester, has been appointed head of the department of pure and applied physics at Manchester Municipal College of Technology.

ACCORDING to the *Journal* of the American Medical Association a division of industrial hygiene in the State Department of Health, Springfield, Ill., has been established to study health hazards under which employees work and make recommendations for preventive measures. Headquarters for the new division will be at the University of Illinois College of Medicine, Chicago, with Dr. Milton H. Kronenberg in charge.

HORACE N. LEE, who for the past three years has been carrying on a special investigation on fibers under the direction of Professor Oakes Ames, under a

research appointment at Harvard University, has joined the staff of Arthur D. Little, Inc., Cambridge.

DR. ALBERT K. KURTZ, who was formerly with the Procter and Gamble Company, has accepted a position in the research department of the Life Insurance Sales Research Bureau at Hartford, Conn., where he will be engaged in psychological and statistical research problems connected with the selling of life insurance.

DR. JOSEPH J. THOMAS, instructor in agricultural and biological chemistry at the Pennsylvania State College, has become associated with the Rohm and Haas Company, of Philadelphia.

PROFESSOR EARL D. HAY, head of the department of mechanical and industrial engineering at the University of Kansas, has been appointed official representative to the third World Power Conference, which will be held in Washington, D. C., from September 7 to 12, to fill the vacancy in the Kansas delegation caused by the death of Dr. George C. Shaad.

DR. HERBERT FRIEDMANN, curator of birds at the U. S. National Museum, Washington, D. C., sailed on August 1 for work in and observation of museums in Italy and in Spain, should conditions warrant, after which he plans to make a collecting expedition in Algeria. He expects to return to Washington by November 20.

A GROUP of American members of the International Union of Geodesy and Geophysics, which meets at Edinburgh from September 15 to 27, sailed from Baltimore on August 20. Among them were: Dr. John A. Fleming, head of the Department of Terrestrial Magnetism of the Carnegie Institution, who is chairman of the International Committee of the Commission on Terrestrial Magnetism and Atmospheric Electricity and of the International Association of Terrestrial Magnetism and Electricity; L. Z. Berkner, physicist in charge of ionospheric research under Dr. Fleming; Dr. R. M. Field, of Princeton University; H. D. Harradon, of the Carnegie Institution; Captain Nicholas H. Heck, chief of the Division of Terrestrial Magnetism and Seismology of the U. S. Coast and Geodetic Survey; W. D. Lambert, mathematician of the survey, and Dr. O. E. Meinzer, geologist in charge of the Division of Ground Water of the U. S. Geological Survey.

THE eleventh congress of the International Society of the History of Medicine will be held in September, 1938, at Athens, Stamboul, Sofia and Zagreb.

THE second International Congress on Gastro-enterology will be held in Paris from September 13 to 15, 1937, under the presidency of Professor Pierre Duval.

THE *Journal* of the American Medical Association reports that a cruise planned for this month by the Latin-American Congress of Physical Therapy, X-ray and Radium, has been postponed to March, 1937. Sessions of the congress will be held in the National University of Medicine at Guatemala City. Dr. Norman E. Titus, New York, is president of the congress; Dr. Madge C. L. McGuinness, 1211 Madison Avenue, secretary, and Dr. Cassius L. De Victoria, 1013 Lexington Avenue, executive director.

THE Smithsonian Institution on August 9 received "birthday" greetings from President Roosevelt and Secretary Ickes, marking the ninetieth anniversary of its establishment, which occurred on August 10. Mr. Roosevelt, writing from Hyde Park, N. Y., to Dr. Charles G. Abbot, secretary of the institution, said: "I can not allow this anniversary to pass without assuring you, and through you, your devoted associates, of my sincere appreciation of the work which you and they are doing. The Smithsonian Institution through nine decades has abundantly justified the hopes and expectations of its founder, James Smithson, who in his will provided for an 'establishment for the increase and diffusion of knowledge among men.'" Secretary Ickes said: "It is significant to me that the institution, with all this panorama of the past, has prepared an exhibit on power for the benefit of the third world power conference. To me this is proof that the contributions of the Smithsonian to-day are as vital as they were in that distant day ninety years ago."

The British Medical Journal reports that the Scientific Association of Pediatrists of Leningrad recently celebrated the fiftieth anniversary of its foundation in 1885, when there were only sixty-three pediatrists in the whole of Russia. Leningrad has now six children's hospitals, seven clinics for children's diseases, twenty-six consultation centers and two institutes for the training of pediatrists.

THE department of forestry of Yale University will receive on the death of Mrs. Oastler the residue of the estate of the late Dr. Frank Oastler, surgeon, vice-president of the Explorers' Club, New York City. The income of the bequest is "to be used for the conservation of wild life, both birds and mammals."

SOHTSU G. KING, the Chinese conchologist and banker, has given his collection on conchological literature to the Science Society of China Library, Shanghai. The collection was started some twenty years ago, while Mr. King was studying Chinese mollusca with Professor A. W. Grabau, of the University of Peking. Under their joint authorship a book entitled "Shells of Peitaiho" was published, besides other scientific papers. The collection includes rare volumes and

not a few complete sets of journals. The total value of the whole collection is estimated at approximately £3,000. The council of the society has passed a resolution to the effect that a special room shall be used to house the collection and shall be labeled "Sohtsu G. King Library of Conchology." A complete catalogue of the library is under preparation and will be printed and circulated to related institutions and learned societies. In addition to the collection Mr. King has provided an endowment, the income of which will be used to continue subscriptions to the journals of which the library possesses back volumes.

DISCUSSION

THE PREGLACIAL PHYSIOGRAPHY OF WESTERN OHIO

LITTLE has been known of the surface which lies buried beneath the glacial drift in western Ohio. The writer examined approximately 20,000 well records, and from these about 6,000 of the most significant were selected and plotted on a base map of western Ohio. The well records were obtained from the Ohio State Water Conservation Commission and the Ohio State Geological Survey. In 1934, geologists and engineers, working on a CWA project, collected 148,000 well records from every county in Ohio. Approximately one half of the state was covered when the project was abandoned. Less than one fourth of the records in western Ohio show the depth of the drift to bed-rock. It was found that because of the limited space on the base map, not all the records could be plotted, and hence only the more significant ones were used. Nearly 10,000 oil-well records from the Ohio Oil Company were furnished by the Ohio Geological Survey. The majority of these are from Wood and Hancock counties, the others coming from Allen, Sandusky, Auglaize, Lucas, Putnam and Hardin counties.

The work of plotting the elevations of the bed-rock on the base map has been completed and a contour map drawn of the buried surface. The following facts have been uncovered. A valley, the continuation of the preglacial Lake Erie lowland, extended in a southwesterly direction. The axis of this valley extends through Lucas, Fulton, Defiance and Henry counties. The stream which occupied this valley the writer calls the preglacial Maumee. It flowed eastward through the depression now occupied by Maumee Bay and probably was a tributary of a large stream which occupied the Lake Erie depression. Another river, the preglacial Sandusky, flowed in a northeasterly direction through what is now Sandusky Bay, into the Lake Erie lowland, where it joined the trunk stream which probably flowed eastward, receiving other large tributaries from the south which drained northern Ohio. The axis of the preglacial Sandusky valley extends through the middle of Sandusky Bay, eastern Sandusky County, Seneca and Wyandot counties. A broad, low divide separated the preglacial Maumee and preglacial Sandusky valleys. To the east of the preglacial Sandusky lies the preglacial Huron Valley, the axis of which extends through Erie, Huron and Crawford counties.

A major divide, a prominent physiographic feature in preglacial time, extended in an east-west direction through Holmes, Knox and Richland counties, continuing beneath the glacial drift in a southwesterly direction through Morrow, Marion and Union counties, where it connects with the buried upland in Logan County, where the highest point in Ohio is located. To the south and west of this buried upland in Logan County is a broad, buried valley once occupied by a preglacial river called the Teays. To the southwest of the Teays valley, in Darke, Miami, Preble and Montgomery counties, the divide widens out into a broad upland which separated the pre-glacial Miami from the Teays drainage. The preglacial or interglacial Miami and Little Miami drainage was to the southwest, as at present. The Teays River has been traced from the south as far as Chillicothe, where it disappears beneath the glacial drift. This stream flowed northward into Pickaway County, where it curved in a northwesterly direction, flowing through Madison, Clark and Champaign counties, where it again curved to the north, around the broad upland in Logan County, through Shelby County, extending in a westerly direction through Auglaize County, continuing through the depression now occupied by Lake St. Mary. From here it extended in a northwesterly direction through Mercer County into Indiana, where it can be traced eastward as a buried depression.

The Teays could not have flowed northward to the Lake Erie depression through Franklin and Delaware counties, as it would have been necessary for the waters to flow over a preglacial divide which stands more than 200 feet higher than the Teays valley, where it disappears beneath the glacial drift at Chillicothe. Nor is it probable that the Teays drained southwestward into the preglacial Miami, since that valley appears to be too narrow in Clark County for so large a stream as the Teays to have flowed through it. Furthermore, it would have been necessary for the Teays to have flowed over a high divide which stood from 980 to 1,000 feet above tide, between the preglacial Miami and Teays valleys.

In preglacial time there were four large drainage basins in western Ohio, as revealed by well records,

the preglacial Maumee, the preglacial Sandusky and Huron, the Teays and the preglacial or interglacial Miami and Little Miami, separated by divides, the major one, including the upland in Logan County, being the controlling feature. The Harrisburg peneplane may be represented by the highest bed-rock elevations in Logan County, and the Worthington erosion surface has a wide extension throughout the area. Lower areas, probably representing the Parker Strath, occur along the buried valleys. Beneath these are the deep, gorge-like valleys which represent the Deep Stage.

In the near future the writer expects to publish the complete results in a paper dealing with numerous details which are treated in a general way here.

KARL VER STEEG

COLLEGE OF WOOSTER

AUTOTOMY IN A PEREGRINE EARTHWORM

NUMEROUS caudal fragments of an unidentified earthworm that had been collected in a living condition from a golf green were submitted, in early June, 1935, to the authors by F. W. Poos, of the Bureau of Entomology and Plant Quarantine, of the United States Department of Agriculture. These fragments averaged 13 mm in length and consisted of from 15 to 23 of the caudal segments. They were reported by a greenskeeper as causing numerous castings on a putting green near Catonsville, Md. This green was investigated by the writers on July 11, a very warm day that succeeded a period when daily temperatures had remained well above 90° F. Numerous earthworm castings, many of them still wet and fresh, were visible on the green. The greenskeeper maintained that these castings were due to fragmentary worms similar to those previously described. Upon removal of a 2-foot square section of sod, however, many active yellowish brown earthworms, 6 inches or more long, were revealed, as well as live fragments of the same. Specimens of these submitted to Dr. Frank Smith at Hillsdale, Mich., elicited the advice that this worm belonged to the genus *Pheretima,* was doubtless a peregrine species and should be sent to Professor R. E. Gates, of Rangoon, Burma, for specific identification. It was at first supposed that the fragmentation observed might represent a habit of reproduction by fission, but a recent excellent work on the earthworms,[1] cited by Dr. Smith, furnished an explanation in what is known as "autonomy," a recognized phenomenon with some earthworms. This consists of the voluntary severance, under certain irritational stimuli, of several segments of the tail, after which the original worm may survive, but the severed fragment, eventually, always dies. Professor Gates subsequently identified the worm as *Pheretima hupeiensis* (Michaelson) 1895, and stated that it had previously been reported twice from Washington, D. C., and once from Philadelphia. Otherwise it is known only from a limited portion of China and Japan. He agreed that the fragments sent him were all autotomized and that this action might have resulted from the previous application of a vermicide to their habitat. This deduction is doubtless correct, as it was learned that mercury, both as chloride and bichloride, had been applied in light dosage several times each year and that lead arsenate, at the rate of 5 pounds to 1,000 square feet of surface, was applied in 1932, and at the rate of 3 pounds each spring thereafter. This amount of poison is easily sufficient to destroy *Lumbricus terrestris* L. and similar species, but evidently served as a mere irritant for this exotic form.

W. R. WALTON

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE
U. S. DEPARTMENT OF AGRICULTURE

JOHN MONTEITH, JR.

U. S. GOLF ASSOCIATION, GREENS SECTION

[1] "The Oligochaeta," by J. Stephenson, Oxford, England, 1930, p. 639.

ANOPHELES (ANOPHELES) NEOMACULIPALPUS, CURRY, EXPERIMENTALLY INFECTED WITH MALARIA PLASMODIA

DURING the latter part of 1935, experiments were begun to determine the infectibility with malaria of certain previously unincriminated species of Anophelines which breed in the Panama Canal Zone and elsewhere in the American tropics. Since that time *A. punctimacula,* Dyar and Knab, a shade-breeding mosquito which is prevalent in Panama throughout the year, has been found naturally infected with malaria plasmodia,[1] and has been proved to be highly susceptible to laboratory infection[2] with both *P. vivax* and *P. falciparum.* These observations and the epidemiological data indicate that *A. punctimacula* is probably an important malaria vector, and that it may be responsible for a considerable part of the malaria infections contracted in unsanitated regions of the Canal Zone.

It is the purpose of this note to announce the experimental infection of another species, namely, *Anopheles (anopheles) neomaculipalpus,* Curry, with *P. vivax.* This mosquito breeds in small collections of sunlit water, being especially common in the hoof-prints and muck of cattle pastures. Further studies will be required to determine the comparative infectibility and the importance of *Anopheles neomaculipalpus.*

From a search of available literature it appears that these two species, *A. punctimacula* and *A. neomaculipalpus,* are the first members of the Arribalzagaia

[1] J. S. Simmons, *Am. Jour. Trop. Med.,* 16: 2, 105, 1936.
[2] J. S. Simmons, SCIENCE, 83: 2150, 269, 1936.

group of Anophelines to be proved susceptible to experimental infection with malaria plasmodia.

JAMES STEVENS SIMMONS
ARMY MEDICAL RESEARCH BOARD
ANCON, C. Z.

EROSION ON THE UPPER RIO GRANDE

IN view of the rapid developments in the field of watershed management, including the handling of lands to prevent destructive floods and accelerated erosion, it is desirable to briefly report outstanding results of a recent survey of the Upper Rio Grande watershed in New Mexico. The study was conducted by the U. S. Forest Service, which has been assigned primary responsibility for research relating to forest and range lands by the Secretary of Agriculture.

On 40 per cent. of the watershed in New Mexico above Elephant Butte Dam, deterioration of the natural vegetation has reached an extreme stage, and the lands are excessively eroded. On 35 per cent. of the area, the plant cover is in a medium stage of deterioration, and erosion is advanced. Evidences of accelerated erosion were found on parts of all the major vegetation-type areas, principally where utilization was uncontrolled.

The natural vegetation has deteriorated as the result of man's activities, principally overgrazing, timber cutting, fire and injudicious dry farming. As a result, accelerated erosion and silt-bearing floods are imperiling land resources and human welfare. Many settlers who formerly made a living by farming are being driven to depend more and more on the grazing of live stock. This has speeded up deterioration of the remaining forage resources and has unloosed a deluge of silt, which threatens to destroy irrigation agriculture in the Middle Rio Grande Valley and to displace the water storage capacity of Elephant Butte Reservoir within the century.

That surface run-off and soil erosion were controlled by natural vegetation for centuries is shown by the good condition of the ground surface of areas that still have protective cover. If land resources are to be preserved the lands must have a protective cover of vegetation. The vegetation on depleted lands must be restored by regulation of use and by artificial revegetation so as to rebuild watershed protective values.

A complete presentation of the results and their relation to land resources and human welfare will be published later this year.

C. K. COOPERRIDER
B. A. HENDRICKS
U. S. FOREST SERVICE

THE OCCURRENCE OF THE AMERICAN BISON IN ALABAMA AND FLORIDA

HORNADAY, in his monograph "The Extermination of the American Bison,"[1] calls attention to the lack of any records of the observation of the American Bison (*Bison Americanus*) in the state of Alabama, although it had been observed in Georgia and Mississippi. The discovery of authentic records of the occurrence of this animal in southern Alabama and adjacent Florida is of considerable interest.

I am indebted to Dr. C. E. Castañeda, of the Latin-American Library of the University of Texas, for transcripts of old Spanish documents relating to the expedition of Marcos Delgado from Apalachee to the Creek country in 1686. The expedition was sent out in an endeavor to discover the rumored colony of La Salle on the Gulf Coast and was perhaps the first penetration of this region since De Soto's time.

Delgado's description of the route of his outward journey is clear and permits quite close identification of his course. Writing of a portion of his path across the present Jackson County, Florida, in an area I identify as lying south of Russ Creek and northwest of Marianna, he says: "Y Caminando al norueste 2 leguas esta un barial que atolla que no lo podran pasar Cauallos en tiempo de aguas que alli Comencan a aber *Cibolas* q son un Genero de animales Como bacas."

And further writing of his passage across what I identify as the vicinity of the Little Choctawhatchee River, probably east of Beaver Creek in the westward extension of Houston County, Alabama, he says: "Caminando al norte Costeando Vn monte Grueso de Castanales Y aCevales Y laureles Y en medio tiene un Rio de 6 bracas de ancho Y dos bracas largas de hondo Y tiene el monte de travesia mas de un quarto de legua Y tiene muchas *Sibolas* Y osos."

MARK F. BOYD
TALLAHASSEE, FLORIDA

SCIENTIFIC BOOKS

EVOLUTION

Evolution. By A. FRANKLIN SHULL. McGraw-Hill Book Company, N. Y. 312 pp., 64 illustrations. 1936.

The Variation of Animals in Nature. By G. C. ROBSON and O. W. RICHARDS. Longmans, Green and Company, London, New York and Toronto. 425 pp. Two colored plates and 30 illustrations in the text. 1936.

THE topic of these books is fundamentally the same, although the first considers both plants and animals, the second only animals. The title of the second book

[1] Report, U. S. National Museum, 1887, p. 380.

does not do it justice, since it includes extensive discussions of natural selection and other theories of evolution, a chapter on adaptation and other matters pertinent to a book of the widest scope. Shull's book, intended to be used in college courses, has the eighteen chapters carefully divided into sections, each dealing with a special topic, set forth as clearly and logically as the nature of the subject may permit, in the present state of our knowledge. The Robson-Richards book, with more than a hundred more pages, goes into more detail and includes a vast amount of interesting information. Owing to the illness of one of the authors, its publication was delayed, and no references to literature later than 1933 are included. Robson and Richards remark (p. 124) that "it has been usual in the past (and the practice is difficult to avoid) to construct all embracing theories on the basis of selected species or genera which supply favorable data; the theories based on the genetics of *Drosophila* or of *Oenothera* are cases in point." To avoid this bias they bring in evidence from many sources, relating to many diverse organisms, but as they do so, the weakness of this material is only too apparent. As suggesting hypotheses, and indicating promising lines for investigation, it is most valuable; but over and over again, upon critical consideration, the authors are obliged to dismiss it as inadequate or inconclusive. It comes to this, that the living organism as a whole has to be considered, in all its relationships, and a true picture can not be obtained except by intensive and long-continued work. It is undoubtedly true that different animals and plants must be studied if we are to present a true picture of the processes of nature, and without the information thus obtained many discussions are essentially sterile. At the same time, there are certain broad considerations which should not be lost sight of in the mass of detail. Shull says (p. 13): "In the difference between two species of the same genus it is usually impossible to see any adaptation." Robson and Richards (p. 314) discuss this matter at great length, and conclude that "a survey of the characters which differentiate species (and to a lesser extent genera) reveals that in the vast majority of cases the specific characters have no known adaptive significance." They give an analysis of the characters of the species of Psammocharid wasps, and I naturally turn to the wild bees, with which I am familiar through long years of study. When I consider the bees, I realize at the outset that we are very ignorant concerning many details of their life history, and thus very incompetent as a rule to state how they may be adapted to their environment. But the fact remains, that the many species have a definite range, whereas, considering their known powers of reproduction, they might be expected to rapidly spread over the country. Some are indeed widely distributed, even beyond the limits of a continent, but many more are restricted to certain regions. This is not a matter of "age and area," it is clearly due to adaptation to particular environments. Not rarely it is found that a species gets its food only from a certain type of plant, or it may be that a special condition makes it possible for it to nest successfully. One who does not believe in adaptation as shown by specific characters may go to my papers and find descriptions of size, proportions of parts, markings, color and what not, and ask what these peculiarities have to do with the life of the species. But these are the "outward and visible signs," as the church catechism says, of a real diversity of the living creatures, a diversity which is obviously connected with the circumstances of their lives. Robson and Richards protest against the appeal to ignorance, saying: "We can not too strongly insist on the point already made that it is no use to attempt to smuggle these facts of specific differentiation into the proof of natural selection by an appeal to ignorance, or by an assumption of correlation, or by pointing out a few cases that seem explicable on very slender and unverified evidence" (p. 274). In reply to this, it seems fair to ask what are the true specific characters? Surely, they are those which separate the species, and no one can doubt that many such characters are invisible in museum specimens. The species do not remain separate without cause, and although this may be physical isolation, as on islands or mountain ranges, it is more usually some adaptation to a special mode of life or special environment. As I write this, there comes to my desk the *Bulletin of Entomological Research*, July, 1936. It contains several articles on the physiological adaptations of insects to their environment, particularly temperature and moisture. Thus (Ullyett, p. 195) "It has been realized for some considerable time that a zone of optimum atmospheric humidity exists for any one [species of] insect, wherein, under favorable conditions of temperature, functional activities are at their maximum." There is, however, a possible source of confusion concerning the meaning of the word adaptation, as a result of the survival of the fittest. Is there any advantage to a species of bee to be obliged to get its food from a particular kind of flower? Presumably not, as those species which are not so restricted are more widely distributed and more numerous in individuals. Thus the origin of species may result from kinds of isolation which are by no means advantageous in themselves, but they do function to promote evolution, and the so-called adaptive characters serve to maintain the species as distinct. In the long run, no doubt the diversity of nature does provide for a much greater abundance of

fe than would be possible without it. In both books e question of the efficacy of natural selection is con-dered at length. Shull has a chapter entitled "De-ine and Revival of Natural Selection." On the last ge of this chapter he says: "And so the theory of tural selection is coming back. Perhaps one should y that it has returned. But it gives signs of being different doctrine. . . . If the doctrine can emerge inus its sexual selection, its warning colors, its imicry and its signal colors, the reaction over the end the century will have been a distinct advantage." obson and Richards say (p. 316): "In short, we not believe that natural selection can be disre-arded as a possible factor in evolution. Nevertheless, ere is so little positive evidence in its favor, so much at appears to tell against it, and so much that is as et inconclusive, that we have no right to assign to it e main causative rôle in evolution." It seems to me at these statements are unsatisfactory. As I see it, tural selection is under normal conditions a conser-ative force. When studies are made of a mutating imal, such as *Drosophila,* it is seen that in general e mutations are disadvantageous, if not lethal. atural selection then hews to the line, and tends to ep the wild types within specific bounds. If it was ue that all organisms presented heritable variations every sort, considering the elimination which goes in every generation, evolution would be so rapid to defeat itself. As a matter of fact, it is in gen-al extremely slow, as may be seen by the study of ssils. But there is no probability that its rate is niform, and when a shift to a new norm does occur, may be rapid. In California certain scale-insects, bjected to poisonous fumes by the horticulturists, ve by a process of the survival of the fittest devel-ped resistant races, not distinguishable by any orphological characters. This sort of thing can cur in the wild, where it will probably escape obser-tion. The phenomena of parasitism are now being udied intensively, and we see how there is a continual me of hide-and-seek, the parasites becoming ad-sted to particular hosts and particular conditions. ut just as with the bees and flowers, some insect para-tes have an amazingly wide range of hosts, while thers are so particular that they enable us to distin-uish between host species which to our eyes are most alike. On the other hand, the hosts (plant or imal) develop powers of resistance.

With regard to that bone of contention, "mimicry," must be said that the resemblances can not be purely cidental. But parallel or convergent variation, gether with what has been called emergent evolution, ill provide plenty of material which may be selected nd preserved when of value to the animals. There re indeed cases which almost suggest some unknown magic, some mysterious influences at present undis-covered. Such a one is that of the minute parasitic *Solenopsia* (Brues, *Psyche,* March, 1936), which lives with the ant *Solenopsis,* and even has the base of the abdomen modified after the manner of an ant. I have imagined a possible reason for this, but the hypothesis is so fanciful, so little supported by evidence, that I do not venture to put it in print.

Robson and Richards urge that many more observa-tions, especially of the living insects and their enemies, are needed. They conclude that "it is probable that selection has played some part in establishing mimetic resemblances," but how large a part, they are not prepared to say. It must always be remembered that, just as the adult insects we see represent only a small fraction of those hatched from the egg, so also the existing species must be regarded as the surviving fragments of a potentially much greater fauna. Their ancestors must have survived periods of "depression," very many of their relatives must have become extinct. The operating causes must have been many and di-verse; as difficult to explain as the fact that, contrary to all statistical expectations, not one of the ancestors of the present writer ever died in infancy.

Robson and Richards conclude with the words: "We have to admit that, if we were to relegate survival value to a subordinate rôle in the causation of evolu-tion, the element of design and purposefulness has to be explained. It is not likely that the mere inter-action of developing parts and their reciprocal effects on one another could produce the ordered and pur-poseful designs which we see in adaptation. For those who believe that all organization is produced by the material processes envisaged by the traditional theories, the scheme of evolution must seem to be clear, at least in outline. For those with whom the diffi-culties we have outlined in this work have any weight it must remain to attempt a clearer definition of the purposeful activity with which we seem confronted."

Shull concludes that "evolution has presumably been all along a mixture of opposing influences. Many of them have been at work simultaneously. The net re-sult of their operation has been an enormous number of types rather sharply defined from one another, most of them rather stable, but all capable of some change. Within each group, among the higher organisms at least, there is the capacity for interbreeding, so that future generations have access to the genes of all present individuals. These groups have constantly within them the sources of variation, consequently evolution must be expected to continue in all of them. There is no group, not even the highest, in which there is reason to think this evolution has come to an end." A weak point in both books is the neglect of paleon-tology. The enormous importance of the past as a

key to the present seems hardly to be appreciated. Even the scanty allusions of the subject are not altogether reliable. In Shull's chapter IV, dealing with fossils, we are informed that bees, wasps, ants and butterflies are known from the Jurassic. This is not at all the case. We read that fossil insects of the Cenozoic era "are not very numerous," in spite of the readily accessible literature describing thousands of species. The statement about the ants of the Sicilian amber in Robson and Richards (p. 131) is wrong, and appears to result from confusion with the Baltic amber.

The real appeal of these books must be to the rising generation. The young naturalists of to-day have an enormous advantage over their predecessors. Much of the necessary taxonomic work, preliminary to everything else, has been done. The science of genetics has been made over, and its contributions illuminate every biological problem. Paleontology, the description, classification and discussion of fossils, has shown astonishing progress. Morphology and physiology are escaping from their traditional isolation, and becoming more and more part of general biology. Chemistry and physics have made their rich contributions in spite of the little appreciation of biological problems shown by the majority of specialists in these subjects. The museums have piled up vast quantities of materials, waiting to be studied by those who have the time and the skill. Expeditions go all over the earth, and travel to many formerly inaccessible regions is now easy. What an opportunity to go to work and instead of arguing as I have done in this review, reveal the actual facts of nature in all their wonderful and beautiful complexity!

T. D. A. COCKERELL

UNIVERSITY OF COLORADO

SPECIAL ARTICLES

THE PRODUCTION OF COSMIC RAY SHOWERS

THE evidence derived from experiments on small bursts[1] indicates that a shower is produced at a single act. A plausible explanation of this result is the following: a high energy electron produces at a nuclear encounter a large number of photons simultaneously. Each of these photons subsequently gives rise to a pair or a Compton electron. Now the classical electrodynamics of point charges is unable to predict anywhere near the number of sprays of photons that is actually observed. Thus either the theory of electrodynamics is wrong or the concept of point charges is so restricted in its scope that it excludes this phenomenon.

In a paper on the annihilation of the proton,[2] the writer introduced the idea that a proton does not exist at all times as a point charge but has a finite probability of dissolving into a positron, a neutrino and a neutron. (That paper then dealt with the problem of the excitation of the β field in a collision with another nucleus.) We know now, however, that the ordinary interaction of the β ray theory is inadequate to explain fully the properties of the β field in the neighborhood of the nucleus. Some new assumption must be made concerning this fictitious charge distribution. Since the properties of the Born system of electrodynamics are similar to those derived from the Dirac-Heisenberg theory of the negative energy states, it is of interest to develop the consequences of the Born theory in this connection. In the close collision of an electron with a nucleus of atomic number Z there appears in addition to the charge distribution of the electron and nucleus a new distribution of charge density. This polarization of the medium arises as a consequence of the non-linearity of the Born system of electrodynamical equations. If we now make the additional assumption which is explicitly contained in the theory, that the polarization charge scatters radiation with the same probability as the true charge density, then we find that the ratio of the probability of the emission of $n+1$ photons at one collision to the probability of the emission of n photons is of the order of 1 to 12 on the average. This result only holds when the energy of the colliding electron ε mc^2 is such that ε lies within the limits $2\times10^3/Z$ to $2\times10^4/Z$. Outside of this energy range, shower production on the Born theory should be absent.[3]

It is the purpose of this paper to present a semi-empirical formulation of the β field which leads to a similar result. From studies of the interaction of protons and neutrons and from the endeavor of physicists to explain the magnetic moment of the proton in terms of the β field, the following empirical distribution of the field has been advanced.[4] On the average the proton is dissolved into a neutron, a positron and a neutrino during 1/10 of the time. During its brief life the positron has an energy of the order of 100 M.E.V. On the basis of this assumption it is possible to develop a theory of shower formation. If a high energy electron $\varepsilon > 137$ collides with this system during the time that the proton is dissolved into a neutron

[1] C. G. and D. D. Montgomery, *Phys. Rev.*, Abstracts, Rochester meeting, 1936.

[2] Bramley, *Phys. Rev.*, 46: 438, 1934.

[3] Bramley, SCIENCE, November 8, 1935.

[4] Bethe and Bacher, *Rev. of Mod. Phys.*, 8: 205, 1936.

positron and neutrino, then there exists a finite probability that the positron will be excited to a higher level of the energy continuum. In this excited state the positron can either escape from the neutron or drop to its original energy state with the emission of radiation. In its ground state it is again possible for the positron to reunite with the neutron to form a proton. Now it is quite possible for the radiation process to take place in either one or many steps. On this picture it is this multiple process which is the origin of the spray of photons found in showers. A calculation of the ratio of the probability of the emission of $n+1$ photons to that of n photons during the descent of the positron from its excited state to the ground state has been carried out. This ratio is $\left(\frac{2}{137\,\pi}\right)\frac{(\log W)^2}{n+1}$, where W is the ratio of the energy of the electron after the $n+1^{th}$ transition to $m\,c^2$. Now this ratio is greater than the classical value 1/137 for those values of the energy ratio W which are greater than $\exp.\sqrt{\frac{(n+1)\pi}{2}}$. For electrons with a smaller amount of energy in the final state the reverse is true. It is the possibility of a value, larger than 1/137, for this ratio, which is the significant feature of this explanation of shower production.

An estimate of the energy of the photons can be determined from the expression for the probability of emission of a single photon. If ν is the frequency of the photon emitted then an approximate value of this probability is $\left(\frac{2}{137\,\pi}\right)\frac{c^2 \log W}{\nu}$; here c is the velocity of light. According to this expression the emission of a relatively soft photon is the most probable event. Thus a shower should be composed of a spray of low energy photons $2\,m\,c^2$.

Besides the production of showers of photons, this process should be accompanied by the emission of a single positron. This production of a positron by the dissolution of a proton is quite a different process from that in which it appears as one member of a pair.

Finally, if the Oppenheimer conditions are applied to this process, an upper limit for the energy $\varepsilon\,m\,c^2$ of the electron capable of producing showers is found again just as in the Born theory, ε max. $(137)^2/Z\,⅓$.

ARTHUR BRAMLEY

SWARTHMORE, PA.

NERVE CELLS WITHOUT CENTRAL PROCESSES IN THE FOURTH SPINAL GANGLION OF THE BULLFROG

THE frog is favorable material for a neurological study of visceral innervation and particularly the relation of sympathetic to spinal nerves because its vertebral column is so shortened that only ten spinal nerves exist and thus the elements contributing to the celiac plexus reveal an exaggerated concentration into a limited locus. The fourth spinal nerve (fifth in early development) carries over half the fibers contributing to the celiac nerve. The two conclusions of particular interest and significance which have come out of this study are, (1) that practically all the neurons whose fibers pass out the communicating ramus to the celiac nerve have their cells of origin in the dorsal root ganglion and (2) that nearly all these neurons lack central processes extending to the spinal cord by way of the dorsal root.

The evidence upon which these conclusions are founded is derived from serial sections of the fourth spinal nerve, roots, ganglion, adjacent sympathetic trunks, rami and celiac nerve stained by silver and osmic methods.

In osmic preparations the myelinated fibers were counted on several nerves and the counts from a representative example are given in Fig. 1. The dorsal

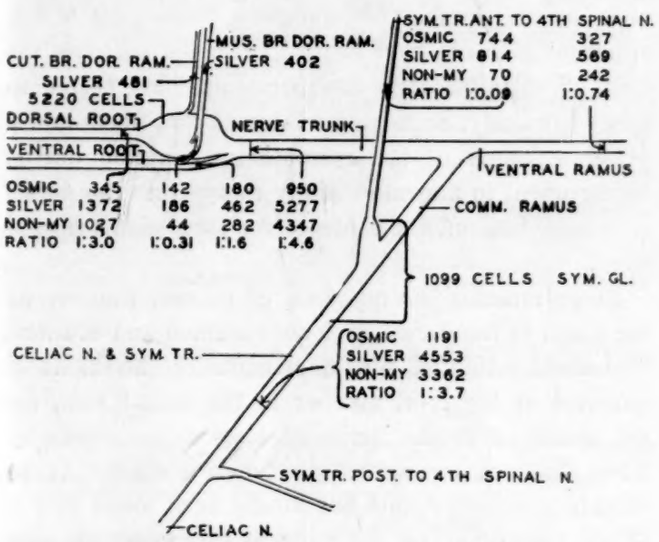

FIG. 1. Fourth spinal nerve of the bullfrog; cut. br. dor. ram. and mus. br. dor. ram., cutaneous and muscular branches of the dorsal ramus; sym. tr. ant. to 4th spinal n., sympathetic trunk anterior to 4th spinal nerve; other abbreviations are self-evident.

root contains 345 fibers and the ventral root (combining dorsal ramus and spinal nerve portions), 322. The total in the two roots is 667 myelinated fibers, of which it is estimated at least 259 are distributed to the dorsal rami, leaving 408 fibers for the spinal nerve distal to the ganglion. In the spinal nerve trunk, however, there are 950 myelinated fibers. The existence of more myelinated fibers in the spinal nerve than in both roots has previously been described by Hardesty[1,2] in *Rana virescens*. The "additional"

[1] I. Hardesty, *Jour. Comp. Neurol.*, 9: 64–112, 1899.
[2] I. Hardesty, *Jour. Comp. Neurol.*, 10: 323–354, 1900.

fibers are small myelinated ones. Most of the large myelinated fibers pass into the ventral ramus, 327 in all, and the small myelinated fibers out the communicating ramus.

When silver preparations are made the discrepancies on the two sides of the ganglion are even more striking. There is a total of 2,020 fibers in the two roots, and if from that number 883 are subtracted which pass to the dorsal rami there are left 1,137 for the spinal nerve trunk. But a cross section of the spinal nerve reveals 5,277 fibers, or an increase of 4.6 fold. Of these 5,277 fibers 569 continue into the ventral ramus and the remainder enter the communicating ramus. The gray ramus consists of relatively few fibers and is not a complicating factor.

All the "additional" fibers come from the dorsal root ganglion. The spinal ganglion cells were counted on two nerves and the average was 5,220 cells, a number which closely approximates the total number of fibers distal to the ganglion. On the basis of fiber and cell counts it would seem that about 3,500 fibers arise in the dorsal root ganglion from cells which apparently do not have central processes entering the cord. Some alternative interpretations have been considered, namely, branching of dorsal root fibers and a possible failure of the sympathetic ganglion during development to migrate distally away from the dorsal root ganglion, but the evidence for them seems insufficient.

There remains the question, of course, whether all the fibers in the dorsal root were stained and counted. The nonmyelinated fibers, constituting about three quarters of the total number in the dorsal root, are not much above the limits of microscopic visibility. Their diameter is about a quarter of a micron. Confirmation of our counts has kindly been made by Dr. H. A. Davenport on the roots of this material. But are these minute entities single fibers or are they two or three or four compressed together within one neurilemma sheath? Such a condition has been observed by Speidel[3] in the growing peripheral nerves of the frog tadpole and by Nageotte.[4] If we are faced with such a situation here, then the separate fibers forming the group are individually below the limits of microscopic visibility and if single fibers of this type exist separately they could not be seen. To postulate that 3,500 nerve fibers were missed because they were invisible presents such complications for this and other work that one hesitates to apply such an interpretation to these data until other more promising avenues of approach have been exhausted.

[3] C. C. Speidel, *Jour. Comp. Neurol.*, 61: 1–82, 1935.

[4] J. Nageotte, "Cytology and Cellular Pathology of the Nervous System," Sect. 5: 189–239, 1932. Paul B. Hoeber, N. Y.

The physiological aspects of this problem now under examination by Dr. G. H. Bishop have thus far confirmed the neurological data and the suggested architecture of the fourth spinal nerve.

ALFRED M. LUCAS

IOWA STATE COLLEGE

JOHN E. MIKSICEK

WASHINGTON UNIVERSITY
SCHOOL OF MEDICINE

THE THERMOPHILIC AND ANAEROBIC NATURE OF LACTOBACILLUS BULGARICUS

As the "bacillus of long life" of Metchnikoff, *Lactobacillus bulgaricus* has been of considerable general interest, and milk fermented with this organism has been a commercial product of importance. Although it is now known that his idea about the identity of the supposedly beneficial organism was erroneous, the basic conception of Metchnikoff has received substantial scientific support through the investigations of the past twenty-five years—hence the more recent and more justly founded popularity of "acidophilus-milk," prepared with *Lactobacillus acidophilus*.

As a matter of fact, it appears that the true *Lactobacillus bulgaricus* has been isolated only a relatively few times. Most bacteriological laboratories carry one or more supposedly authentic cultures of this organism, but if one makes a collection of these and obtains as much as is available of their histories, it is found that those cultures which have the characteristics of the true *Lactobacillus bulgaricus* trace back to a small number of original strains. Among those who are not especially familiar with the species, it is frequently thought that *Lactobacillus bulgaricus* is the most common lactobacillus of milk. This is not the case; an uncritical approach usually results in the isolation of *Lactobacillus casei*, a more abundant and easily isolated organism, or some of the other lactobacilli, rather than *Lactobacillus bulgaricus*. The true habitat of the organism is not known, and it has not been isolated from nature; it is commonly referred to as a "milk organism," but it is known to occur there in very small numbers, and, so far as we are aware, it has seldom, if ever, been isolated from fresh milk. In common with others, we have frequently isolated *Lactobacillus bulgaricus* from Swiss cheese, but this feat probably represents only the reisolation of the well-domesticated culture which had been used as a "starter" in the making of the cheese. Most of the laboratory cultures of *Lactobacillus bulgaricus* were originally isolated from natural fermented milks, such as jugurt, which are propagated from batch to batch over long periods of time. Although not attaining to a pure culture status, the process becomes highly selective, and we think

there is some reason to believe that such culturing brings about some of the same changes as occur when it is propagated in the laboratory in pure culture.

We have recently isolated more than 200 cultures of *Lactobacillus bulgaricus* from fresh milk and have thus obtained a more adequate picture of the group as a whole than was heretofore available. What have been considered the prime distinguishing characters of this organism stand out in even bolder relief in these freshly isolated cultures. In a few characteristics, however, they vary from the conventional laboratory strains. For example, the new cultures do not grow as rapidly in milk, but this point should not surprise those who have given any thought to the subject of bacterial ecology.

With the application of proper selective methods, followed by dilution transfers, it was easy to obtain the cultures in substantially, if not strictly, pure cultures. Upon plating to obtain colony isolation, in the majority of cases, growth was not obtained either on aerobic plates or on those incubated anaerobically. At the suggestion of Professor Georges Knaysi, .05 per cent. sodium sulfite was added to the agar medium and the plates were incubated aerobically. All cultures yielded colonies on this medium and pure culture isolations were easily made. Probably the colony isolations could have been made by the conventional anaerobic methods—perhaps our technique was faulty—but, with such competent expert advice ready at hand, it was not necessary to lose further time with the more cumbersome methods. Although this rather strongly anaerobic nature of *Lactobacillus bulgaricus* appears to have been missed in the past, it is not especially surprising. The lactobacilli as a group are facultative with a distinct preference for anaerobic conditions on the part of a number of the species. Some of the other lactobacilli also behave as true anaerobes when freshly isolated and become facultative upon continued laboratory culture.

The more interesting new point about *Lactobacillus bulgaricus* is its thermophilic nature. Old laboratory cultures of this organism usually have maximum temperatures of growth around 50° C. A majority of the freshly isolated strains grow at 60° C., and vigorously at 55° C. While only a small proportion of the newly isolated cultures have failed to grow at these higher temperatures, out of a small collection of 18 strains, which were isolated and carried in the laboratory for about a year before testing, only six can grow at temperatures substantially above 50° C. This may be a coincidence, but we think not. Of three stock cultures of *Lactobacillus bulgaricus* which have been under artificial cultivation for many years, only one is now able to grow at 50° C.

For certain technical applications the thermophilic nature of newly isolated strains of *Lactobacillus bulgaricus* has an important significance.

J. M. SHERMAN
H. M. HODGE

CORNELL UNIVERSITY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A HIGH SPEED CRYSTAL INK WRITER

VARIOUS oscillographs in use for following transient electric potentials depend on photographic recording, with the attendant trouble and delay of developing the record and the expense of equipment and film. This latter is especially serious when long-continued records are desirable, as in recent electrical studies of the brain. Ink writers, in turn, have been limited to relatively low frequency signals, the best so far described giving responses of approximately correct amplitude only below fifty cycles per second.

The instrument here described is novel in that a piezo-electric crystal, rather than an electro-magnet, drives the pen. Besides improved frequency characteristics, this "Crystograph," as we have called it, possesses other advantages: no polarizing current or voltage is required; efficiency is high, a quarter of a watt of power giving deflections of two centimeters; a high impedance permits direct resistance-capacity coupling to the output of any amplifier supplying sufficient voltage (about 500 R. M. S. maximum) and power; its impedance characteristic also permits

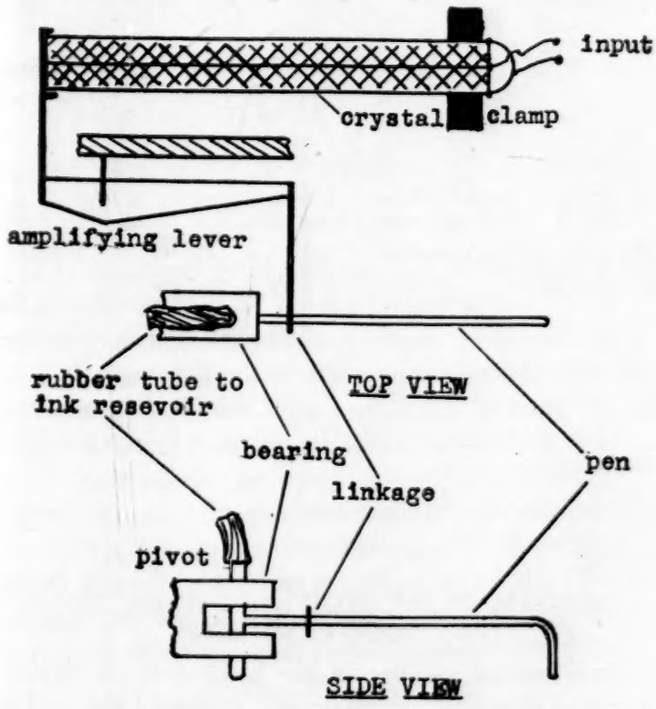

FIG. 1. Diagram of Crystograph.

simple electrodynamic damping by an impedance in series with the input.

The motion of a "bimorph" type Rochelle salt crystal is transmitted through an amplifying lever to a pen of stainless steel tubing designed for maximum strength consistent with low moment of inertia (Fig. 1). One or more of these write on 1⅛ inch paper tape moving at a speed up to 20 cm/sec, the highest justified by the frequency characteristic of the Crystograph. Response amplitude is practically independent of frequency to 130 cycles per second; within 40 per cent. to 190. Figure 2 shows the frequency characteristics.

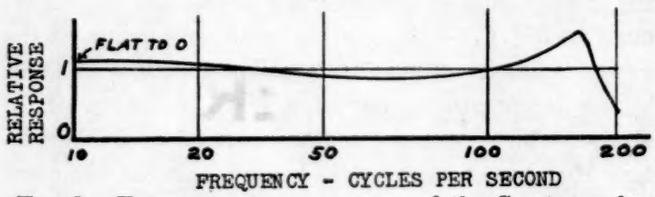

FIG. 2. Frequency response curve of the Crystograph.

With this frequency range, greater than that of the string galvanometer as ordinarily used, it is possible to obtain satisfactory ink electroencephalograms and electrocardiograms, and to study potentials and discharge frequencies of central nervous system, muscle and even peripheral nerve, except for spike shape. The Crystograph may also be useful in the physical sciences, as in recording number and amplitude of Geiger counter discharges.

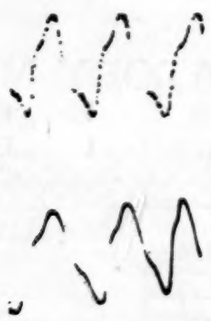

FIG. 3. Typical wave forms obtained from the Crystograph (above) compared with the cathode ray oscillograph (below). A distorted 60 cycle wave.

We hope to be able to present more details concerning the construction and uses of the Crystograph in a future issue of the *Review of Scientific Instruments.*

FRANKLIN OFFNER
R. W. GERARD

DEPARTMENT OF PHYSIOLOGY
UNIVERSITY OF CHICAGO

ANOTHER METHOD OF PREPARING DISTRIBUTION MAPS

THE method of placing the black dots on outline maps as described by Hubricht[1] reminded the writer of the method which she had used for a number of years. The type of one-cent pencil which has the more or less conical eraser attached within the wood is necessary. By means of a safety razor blade the eraser may be sectioned horizontally until the area of the end of the eraser is equal to the size of the dot desired. By dipping the end of the rubber into india ink and then using the eraser as a stamp, black dots of uniform size and color intensity may be placed upon the outline maps. The method is quick and the dots are photographed very satisfactorily.

WINONA H. WELCH

DEPAUW UNIVERSITY

[1] SCIENCE, 84: 48, 1936.

LABELING MUSEUM SPECIMENS AND LABORATORY EQUIPMENT

THE following method was devised and has been found quite satisfactory at Ashland College.

An electric stylus and white or colored transfer paper (obtainable from Demco Library Supplies, Madison, Wisconsin), such as are used by librarians to mark the backs of books, are used to burn the desired labels on various objects. Rough objects should be made smooth by filing. After the label is dry it may be shellaced.

The method has been successfully tried on the following: fossils, rocks, mollusca shells, wood fungi, arrow heads, microscope base, projection lantern, ground glass stoppers and plain glass, after treatment with the fumes of hydrofluoric acid.

The chief advantages of this method over the gummed label method are: that the specimens can be washed without injury to the label; the size of the labels can be varied to suit the size of the specimens; the labels are neat, permanent, inexpensive and can be done by any one who can print or write well.

E. E. JACOBS
MARY AUTEN

ASHLAND COLLEGE

BOOKS RECEIVED

Anales de la Universidad Central. Tomo LXI, Num. 296. Abril—Junio de 1936. Pp. 351. Illustrated. Universidad Central del Ecuador, Quito. Numero suelto, $2.00.

CURRIER, L. W. *Zinc and Lead Region of Southwestern Virginia.* Bulletin 43 of the Virginia Geological Survey. Pp. xii + 122. 26 plates. PARK, C. F., JR. *Preliminary Report on Gold Deposits of the Virginia Piedmont.* Bulletin 44. Pp. viii + 42. 14 figures. The Survey, University, Virginia.

KAHN, R. L. *Tissue Immunity.* Pp. xix + 707. Illustrated. Thomas. $7.50.

Report of the National Research Council of Japan. Vol. II, No. 4; April, 1934–March, 1935. Pp. 2 + 100. The Council, Tokyo.

Television. Addresses and Papers. Vol. I. July, 1936. Pp. viii + 452. Illustrated. RCA Institutes Technical Press, New York.

Yearbook of Agriculture, 1936. Pp. 1189. Illustrated. Government Printing Office, Washington. $1.25.